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ABSTRACT

This document highlights points made in papers presented in the two scheduled sessions devoted to issues in mathematics education affecting minority students at the 1980 National Council of Teachers of Mathematics (NCTM) conference. The first meeting was part of the official NCTM conference program. The second meeting was sponsored by the National Institute of Education (NIE). Points from a total of three papers presented over the two meetings are discussed. A paper concerned with verbal problem solving in mathematics among Chicano students is the first to be summarized, as it was only discussed at the NCTM session. The other two were further discussed at the NIE-sponsored meeting. Broad areas of ideas from both these papers are combined in a summary that reviews the following topic areas: bilingual education, curriculum, teaching and teacher training, ethnography, testing, and basic research. It is noted that there is a general lack of replications of research studies with minority students on findings and practices that are from mathematics education research that focus on the majority. It is felt the absence of such replications adds to the dubiousness of purportedly generalized outcomes, and needs to be remedied. (MP)

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FIRST GLANCES AT LANGUAGE AND CULTURE IN MATHEMATICS EDUCATION

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First Glances At Language and Culture In Mathematics Education

By

Luis Ortiz-Franco

The mathematics education of bilingual students is a complex question to consider. There is a dearth of information on this topic since it appears that researchers have done little investigation in this area. On the one hand, the emergence and development of mathematics education and its accompanying empirical investigations have not addressed, for the most part, issues and questions related to minority students in general, and to linguistic and culturally different students in particular. On the other hand, investigations in bilingual education as well as bilingual school programs have also remained distant from addressing these issues.

In 1972, Begle conducted a study investigating some learning correlations among Chicano and non-Chicano students. One finding was that the pre-tests did not correlate with the post-tests for Chicano students as well as they did for the non-Chicano pupils. This finding motivated Begle (1973) to state that cultural factors should not neglected when assessing mathematics education of Chicano students.

Since then, there have been several studies addressing different aspects of this intricate problem relating to the mathematics education of bilingual students. (Begle et. al., 1975, Begle et. al., 1975, Ginther and Begle 1975, Ortiz-Franco 1977, and Tsang 1976.)[1] More recently, Lovett (1980) discussed aspects particularly relevant to the teaching of mathematics to bilingual students. He identified three major areas of concern: (1) language of instruction; (2) cultural referents; and (3) cognitive styles. These and other topics will be touched on in this article.

During the 1980 National Council of Teachers of Mathematics (NCTM) conference in Seattle, Washington, two of the scheduled sessions were devoted to the discussion

of issues in mathematics education affecting minority students. One meeting was part of the official NCTM conference program entitled "Language and Culture In the Mathematics Curriculum of the 80's" on Thursday, April 17, 1980.[2] The second meeting was held the following day and it was sponsored by the National Institute of Education (NIE) independent from NCTM. The NIE sponsored meeting was organized to discuss the salient issues in mathematics education research for minorities.[3] Topics concerning Asian Americans, American Indians, and Chicanos were discussed.[4]

The purpose of this article is to share with the mathematics education community the highlights of these two meetings.

PROCEEDINGS FROM THE MEETINGS

The NCTM Session. Two of the three papers presented at the NCTM session were further discussed in the NIE sponsored meeting but this was not the case for the third one. The latter was concerned with verbal problem solving in mathematics among Chicano students and it is summarized below. The other two are summarized in another section.

A reanalysis of the data from a small empirical study reviewed in the third paper suggests the plausibility of different cognitive structures between Spanish-speaking and English-speaking Chicanos. Different reliability patterns of some achievement tests, some test results of psychological processes and data from a set of mathematical verbal problems for these two populations were reported. This data, in turn, resulted in different intercorrelations of the measures administered.[5]

The cultural referents of the original English versions of the tests were modified to match the cultural context of those students who participated in the study. Subsequently, the instruments were translated into Spanish. The modified English version was administered to the English-Speaking Chicanos and the Spanish version was administered to the Spanish-Speaking Chicanos.

At least four major plausible inferences can be drawn from these data.

1. Matching cultural referents in tests to the culture of English-Speaking Chicanos may be necessary but it is not sufficient for assuring test reliability;
2. The different intercorrelation coefficients are indicative of different cognitive structures between these two samples belonging to the same cultural group. The implication may be that differences in cognitive structures may exist between and within cultural groups;
3. The reliability coefficients indicate the need to develop tests for psychological processes for English-Speaking Chicanos;
4. The tests for psychological processes can be translated from one language (English) to another (Spanish) without losing their reliability.

The remaining portion of this essay highlights the major points contained in the papers presented at the NIE sponsored meeting.

The NIE Meeting. The NIE meeting proceeded in two parts. The first part was a general discussion, and the other consisted of a presentation of the documents prepared for the meeting. Of the many points made in the general discussion, two closely interrelated aspects merit mention here. The paucity of mathematics education research investigating questions affecting minorities was lamented and participants urged federal and professional agencies to devote more resources to this area. Also, participants deplored the small number of minority mathematics education researchers in the U.S.

Now, let us consider the two papers presented. The ideas from both of them can be categorized into six broad areas: bilingual education, curriculum, teaching and teacher training, ethnography, testing, and basic research.

Bilingual Education. Direct and indirect observations of bilingual education in practice provide the background of the papers. The documents make it clear that, by oversight or intent, mathematics education has been largely ignored in most

of the bilingual education programs in the schools. Most often than not, students in bilingual programs receive mathematics instruction in English. The comparative efficacy of this practice has not been widely evaluated.

In the view of some of the authors, there is a lack of perspective regarding the place and role of mathematics in the bilingual elementary school curriculum. This aspect needs further scrutiny.

Curriculum. The articles make the following ovservations pertaining to mathematics and bilingual education.

1. There are no complete, coherent, and comprehensive bilingual elementary school mathematics programs available;
2. Many topics in mathematics are independent of language and culture provided that the fundamental preskills have been adequately strengthened;
3. The development of quality bilingual mathematics materials emphasizing learning by seeing, doing, and participating needs attention;
4. Investigations addressing the question of how much mathematics knowledge and skill immigrant students have are notoriously absent. This in turn frequently leads to improper decisions concerning the placement of these students in the existing local curriculum;
5. Studies comparing the mathematics curriculum prevalent in the U.S. and in the country of origin of immigrant students should be undertaken.

Teaching and Teacher Education. The documents mention the following points with respect to this topic.

1. When teaching mathematics to bilingual students in a bilingual atmosphere, teachers should have (a) an adequate command of the technical math vocabulary in the language involved; (b) a sound preparation in the mathematical concepts of the elementary school curriculum; (c) techniques for minimizing the effects of the language and cultural variables with the purpose of maximizing mathematical thinking and mathematical processes;

2. More emphasis on mathematics is needed in the preservice training programs for prospective elementary school teachers in order to increase their effectiveness in teaching mathematics;
3. Preservice mathematics education programs for teachers should (a) encourage prospective teachers to utilize homemade teaching materials; (b) facilitate first hand experience in problem solving and applications of mathematical concepts in a variety of different situations; and (c) enable prospective teachers to develop math labs and math interest centers.
4. Courses integrating mathematics content, information about the learning characteristics of children, and mathematics teaching methods are needed.
5. Bilingual mathematics specialists should be used at the K-6 level to impart mathematics instruction in the vernacular language of the students.

Testing. Four major points in the area of testing can be discerned from the essays.

1. Tests in English, standardized or not, do not measure accurately the knowledge and academic achievement of bilingual students. Adequate testing instruments need to be developed.
2. Local school districts ought to move away from adhering to national norms and develop local ones as more realistic indicators of mathematics achievement.
3. It is frequently the case that bilingual and minority students get low scores on tests due to unfamiliarity with the necessary test marking strategies. These students should be taught test taking techniques so that their actual knowledge can be more accurately assessed.
4. Item analysis, test reliability and validity ought to be integral parts of the testing process when bilingual students are involved.

Ethnography. Bilingual communities in the U.S. are known to undergo changes in their population make-up more frequently than the non-bilingual communities.

Attention must be given to these factors in order to better meet the mathematics education needs of the students involved. For instance, it has been observed in the past that Asian American students usually demonstrate a higher mathematics achievement that any other minority group. This in turn has led to the belief that Asian American students do not really have any problems in coping with mathematics. However, the increased influx of Asian immigrants to this country in the last few years has drastically changed the characteristics of the Asian American Community. Thus, many of the previously held assumptions about this population must now be reexamined.

The Hispanic community is not exempted from this phenomenon.

Basic Research. Empirical investigations studying different aspects of mathematics learning among bilingual and minority students in the U.S. are very few. This lack of data and knowledge base does not permit generalizations regarding the differences or similarities in the learning of mathematics between these populations and the majority population. However, there is some evidence suggesting that differences do exist due to culture. Whether these differences stem from different learning patterns, cognitive structures, social variables, or linguistic factors remains to be investigated.

The following topics are identified as needing systematic investigation:

1. Longitudinal studies with an appropriate developmental program for students (minority and/or bilingual) who are not expected to learn mathematics nor reading;
2. Longitudinal studies designed to generate information regarding the cognitive skills that may be precursors to mathematical thinking, concepts, and skills;
3. The cultural meaning of numerosity (numerousness) as being different in different cultures, and whether high achieving students may not be affected by the cultural content of mathematics verbal problems;
4. Ethnographic approaches to error patterns in mathematics, and to problem-

solving processes;

5. Inquiries as to what degree the pattern of reading (left to right), teaching practices, and linguistic and cultural contexts affect the meaning of equality.

CLOSING REMARKS

Additional details and other points not reviewed in this article may be read in the volume containing the papers (see note 4). It should be observed that mathematics education research in particular, and mathematics education in general, can be more reliable if findings and practices can be found in replicated research studies with minority students. The absence of such replications only add to the dubiousness of what purports to be generalized outcomes. It is time to strive to develop a sound mathematics education discipline for all and not just for the majority.

NOTES

1. This article by Ginther and Begle later evolved into a Ph.d. dissertation by Ginther (1976): DAI, Vol. 37, No. 2, Page 851-A. A briefer version of the dissertation appeared in Journal For Research In Mathematics Education, Vol. 9, No. 2, March 1978, pages 118-125, also authored by Ginther.
2. The panelists at the NCTM session were Tony Gallegos, Department of Education, Highlands University, Las Vegas, New Mexico; Luis Ortiz-Franco, NIE; and Sau-Lim Tsang, Asian American Bilingual Center, Berkeley, CA.
3. A total of eight people participated in the NIE sponsored meeting. These included the three panelists of the NCTM session and Alberta M. Castaneda, Department of Curriculum and Instruction, University of Texas at Austin; Hilda Serna, Elementary School Teacher in the Laredo School District, Laredo, Texas; Dora Serna, Mathematics Instructor, Laredo Community College, Laredo, Texas; Claudette Bradley, Ph.D. student, Harvard University; and Ed Esty, NIE.
4. The proceedings of the NIE sponsored meeting is available through ERIC under the title "Salient Issues In Mathematics Education Research for Minorities", compiled by Luis Ortiz-Franco, ED 191 699.
5. The study referred to here is that of Luis Ortiz-Franco (1977). Analysis of the data subsequent to the Ph.D. study revealed that three of the seven tests administered to the English-speaking Chicanos showed a Cronbach - reliability coefficient lower than 0.5. Those tests with such a low reliability were Necessary Arithmetic Operations, Syllogistic Reasoning, and Problem Solving Inventory (PSI). The spanish version of all seven tests showed a Cronbach - reliability coefficient higher than 0.5 when administered to Spanish-speaking Chicanos.

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